
ऑक्सीजन, संपीड़ित गैस और तरल — विशिष्टि
(पांचवां पुनरीक्षण)

Oxygen, Compressed Gas and
Liquid — Specification
(Fifth Revision)

ICS 71.100.20

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FOREWORD

This Indian Standard (Fifth Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Industrial Gases Sectional Committee had been approved by the Chemical Division Council.

This standard was originally published in 1956 and subsequently revised in 1965, 1974, 1992 and 2005. In this revision, the following major changes have been made:

- a) Incorporation of liquid oxygen as there was no such standards available as on date and with a view to harmonize it with IS 5760 : 1998 Argon, compressed and liquid — Specification;
- b) Incorporation of magneto-dynamic oxygen analyzers for the determination of oxygen content with a view to further harmonize it with corresponding British Standard BS 4364 : 1993 'Specification for industrial oxygen';
- c) Introduction of two more grades; Grade 1 (very high purity grade) and Grade 2 (high purity grade) along with Grade 3 (commercial grade) already specified in earlier version. Grade 2 also represents requirements for liquid oxygen; and
- d) Use of sophisticated instruments using principles of cavity ring down laser absorption spectroscopy, spectra analysis, IR spectroscopy and gas chromatography.

At present, there is no ISO standard on the subject.

As stringent limits of impurities have been prescribed for Grade 1 and Grade 2, analysis of these grades of oxygen demands the employment of sophisticated modern instruments having high degree of sensitivity and precision. In view of this, the conventional oxygen assay determination using glass test sets and apparatus have been restricted for Grade 2 and Grade 3. The equipment and the instruments prescribed for analysis in this standard are modern instruments with high degree of reliability.

The composition of the Committee responsible for formulation of this standard is given in Annex D.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

OXYGEN, COMPRESSED GAS AND LIQUID — SPECIFICATION

(*Fifth Revision*)

1 SCOPE

This standard prescribes requirements and methods of sampling and test for oxygen, compressed and liquid.

This standard does not cover aviation oxygen and that for medical or inhalation purposes.

2 REFERENCES

The standards given below contain provisions, which through reference in this text constitute provisions of this Indian Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this Indian Standard are encouraged to investigate the possibility of applying the most recent editions of these standards:

<i>IS No.</i>	<i>Title</i>
IS 4905 : 2015 ISO 24153 : 2009	Random sampling and randomization procedures (<i>first revision</i>)
IS 7062 : 1973	Glossary of terms used in gas industry
IS/ISO 17034 : 2016	General requirements for the competence of reference material producers

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 7062 shall apply.

4 GRADES

There shall be three grades of oxygen, namely;

- a) *Grade 1* — very high purity grade oxygen to be used for calibration purpose and/or in fulfilling requirements where there is demand of minimization of impurities with higher assay value.
- b) *Grade 2* — high purity grade oxygen for use in laser cutting as an assist gas for automotive, textile machinery industries where the quality of surface after cutting are enhanced significantly compared to usage of normal commercial grade oxygen.

Liquid oxygen specification has been aligned with this grade and all the measurements for the liquid shall be done in gas phase only.
- c) *Grade 3* — commercial grade oxygen for use in welding industry and for other metallurgical operations.

5 REQUIREMENTS

5.1 The material shall be compressed gas or liquid after vaporization.

5.2 The material shall comply with the requirements prescribed in Table 1 when tested in accordance with the corresponding methods prescribed in col (6).

Table 1 Requirement for Oxygen, Compressed Gas and Liquid
(Clause 5.2)

Sl No.	Characteristic	Requirement			Method of Test, Ref to
		Grade 1 (N3.5)	Grade 2 (N2.5)	Grade 3 (N2.0)	
(1)	(2)	(3)	(4)	(5)	(6)
i)	Oxygen, percent (v/v), <i>Min</i>	99.95	99.5	99.0	A
ii)	Nitrogen, ppm, <i>Max</i>	100.0	100.0	—	B-1 or B-6
iii)	Water vapour, ppm, <i>Max</i>	1.5	2.0	67	Any of B-3, B-7, B-8, B-9, B-10
iv)	Carbon dioxide, ppm, <i>Max</i>	0.2	0.5	2.0	Any of B-1, B-2, B-3, B-4
v)	Carbon monoxide, ppm, <i>Max</i>	0.2	0.5	3.0	Any of B-1, B-2, B-3
vi)	Hydrocarbons, ppm, <i>Max</i>	10.0	20.0	50.0	Any of B-1, B-2, B-3, B-5

NOTES

1 Oxygen gas produced by air separation shall not normally contain any carbon monoxide, carbon dioxide and hydrocarbon. So, for the presence of these impurities in oxygen, compressed gas and liquid produced by air separation process, tests shall be carried out only on agreement between the buyer and the seller. For oxygen (both compressed and liquid) produced by other methods, the determination of the mentioned impurities, that is, carbon monoxide, carbon dioxide and hydrocarbon shall be carried out along with other tests mentioned in Table 1.

2 For determination purity of oxygen of Grade 2 and Grade 3 both **A-1** and **A-2** methods can be used but in case of dispute the **A-1** method shall be considered as referee method.

6 PACKING AND MARKING

6.1 The gas shall be supplied compressed in cylinders or liquid oxygen tanks or portable cryogenic containers. The design of cylinders or liquid oxygen tanks or portable cryogenic containers, the maximum pressure of oxygen in them, and packing, marking, painting, labeling and transport of cylinders tanks shall be in conformity with the *SMPV Rules, 2016* and *Gas Cylinder Rules, 2016* of the Government of India, with modifications as may be ordered from time to time by Petroleum and Explosive Safety Organization (PESO) or any other authority duly constituted by the Government of India.

6.2 The quantity of oxygen gas packed in a gas cylinder shall be measured at 27 °C and 760 mm of

Hg and shall be expressed in cubic meter.

6.3 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act, 2016* and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

7 SAMPLING

The method of drawing representative samples for both compressed oxygen and liquid oxygen, number of tests to be performed and the criteria for conformity of the material to the requirements of this specification shall be as prescribed in Annex C.

ANNEX A

[Table 1, SI No. (i)]

DETERMINATION OF PURITY OF OXYGEN

A-1 PARAMAGNETIC SUSCEPTIBILITY METHOD**A-1.1 General**

This method can be used to determine the purity of all grades of oxygen.

A-1.2 Principle

The method uses the principle of paramagnetic susceptibility, a physical property which is considerably greater in oxygen than in other common gases. Oxygen molecules are more strongly attracted by a magnetic field than are molecules of other gases, most of which, being diamagnetic, are repelled by a magnetic field.

Magneto dynamic analyzers are based on Faraday's

method of determining the magnetic susceptibility of a gas by measuring the force developed by a strong non-uniform magnetic field on a diamagnetic test body suspended in the sample gas. The test body of all measuring cells in paramagnetic oxygen analyzers consists of two nitrogen-filled quartz spheres arranged in the form of a dumb-bell, as shown in Fig. 1.1. A single turn of platinum wire (the feedback coil) is secured in place around the dumb-bell. A rugged, taut band platinum ribbon suspension attached to the mid-point of the dumb-bell positions the dumb-bell in the strong non-uniform magnetic field existing between the specially shaped pole pieces of the permanent magnetic structure (*see* Fig. 1.2). A typical analyzer configuration (electronic) is shown in Fig. 1.3.

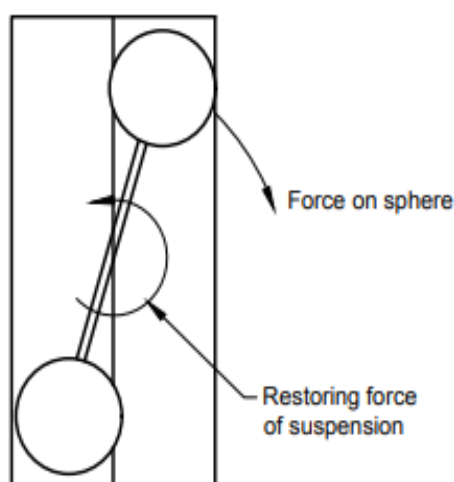


FIG. 1.1 DUMB-BELL SYSTEMS : FORCES WITHIN THE CELL

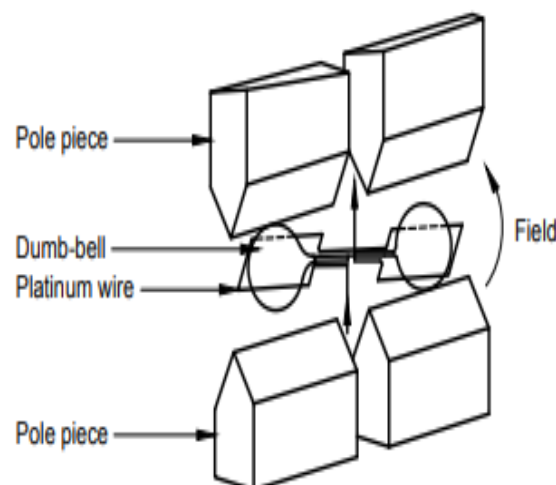


FIG. 1.2 MEASURING CELL CONFIGURATION

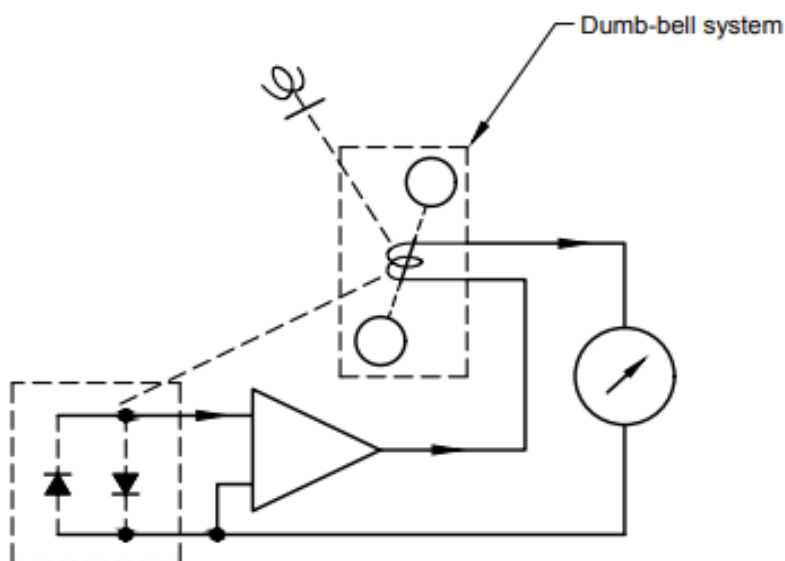


FIG. 1.3 TYPICAL ANALYSER CONFIGURATION (ELECTRONIC)

A-1.3 Instrument

A variety of analytical equipment suppliers provide simple, ready to run portable units for this purpose, which may be powered either by battery or by mains electricity. Fig. 1.3 illustrates the configuration of a typical unit designed for this purpose. The resolution of the instrument shall be minimum 0.1 percent in case of Grade 2 and Grade 3 while that for Grade 1 shall be 0.01 percent.

A-1.4 Calibration

Calibration of these units shall be carried out using a calibration standard that is assured by analysis traceable gravimetrically to national standards and of purity greater than 99.95 percent (v/v) oxygen and the instrument manufacturer's instruction in this regard, shall be followed.

A-1.5 Procedure

After calibrating the instrument, introduce the sample of the product in accordance with the instrument manufacturer's instruction. Record the oxygen content that is displayed by the instrument.

A-2 DETERMINATION OF PURITY OF OXYGEN (GRADE 2 AND GRADE 3)

A-2.1 General

This method can be used to determine the purity of Grade 2 and Grade 3.

A-2.2 Quality of Reagents

Unless specified otherwise, pure chemicals and distilled water (*see* IS 1070) shall be employed for tests.

NOTE — "Pure Chemicals" shall mean chemicals that do not contain impurities, which affect the result of analysis.

A-2.3 Apparatus

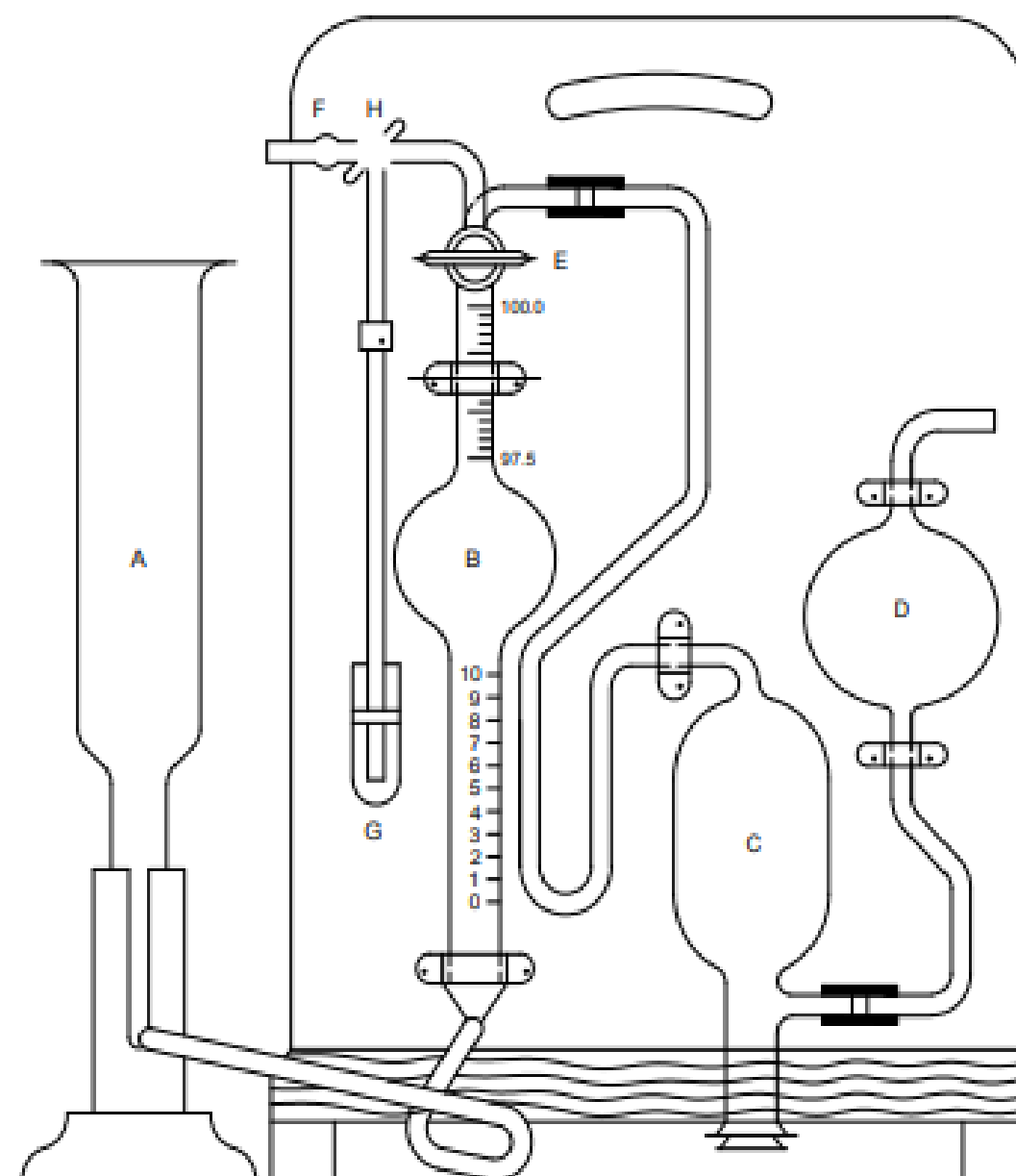
The apparatus shall be as shown in Fig. 2.

A-2.4 Reagents

A-2.4.1 Copper Wire

A-2.4.2 Ammonia Solution

Dissolve 550 g of ammonium chloride (NH_4Cl) in 1 085 ml of water and to this solution add 917 ml of ammonium hydroxide solution (relative density 0.90).



- A = LEVELING TUBE
- B = GRADUATED BURETTE FOR OXYGEN TESTING
- C = COPPER WIRE CONTAINER
- D = RESERVOIR FOR SOLUTION
- E & H = THREE-WAY STOP COCKS
- F = INLET FOR GAS SAMPLE
- G = LUTE

FIG. 2 ASSEMBLY OF APPARATUS FOR DETERMINATION OF OXYGEN

A-2.5 Procedure

A-2.5.1 Invert the copper wire container C, remove the bung and fill it with copper wire in spiral or other form. Then fill it with ammonia solution and replace the bung. Return C to upright position. Pour the ammonia solution into the levelling tube A until it is about three quarters full. Then operate the three-way stopcock E and H so that burette B is in communication with the atmosphere through inlet E, and by raising levelling tube A, completely fill burette B. Keeping A raised, turn E, so that B is in communication with C, and allow the solution to pass into C, until D is half-full. Close E, lower A and operate E to draw from C into B. Close E, when capillary of E is full of liquid. Raise A and operate E to expel gas from B to atmosphere through F, closing E when the capillary H is full of liquid. Fill the lute G with a head of about 50 mm of water and connect F with sample gas and purge the gas from the lute G. Draw in the sample through F (taking care that no air is sucked in through F during this operation), until the liquid level in B is at the zero mark and is at the same level with that in A. Pass the gas into C by suitably operating the cock B, and raising A. Shake thoroughly and then draw back the unabsorbed gas into B by lowering A and operating

the cock E until a little solution from the capillary trickles down into Bin order to ensure that the capillary in the plug of cock E is filled with liquid before leveling up and reading the volume of the gas. Repeat the process a number of times until no further absorption takes place.

A-2.5.2 Renewal of the Solution

When the solution is spent, close E, remove the bung from C and drain out the solution from C and D. Invert C and fill it with fresh solution. Replace the bung and set C and D in proper places and in upright position. Now add fresh solution to the partially spent solution of A and repeat the process as indicated under **A-2.5.1**.

A-2.6 Calculation

$$\text{Oxygen present by volume} = \frac{(V - V_1) \times 100}{V}$$

where

V = volume of the gas sample taken for the test, in ml; and

V_1 = volume of the gas after absorption, in ml.

ANNEX B

[Table 1, SI No. (ii), (iii), (iv), (v) and (vi)]

DETERMINATION OF IMPURITIES

B-1 GAS CHROMATOGRAPHIC METHOD

B-1.1 Principle

Chromatography is a process of separation achieved by means of a partition between a stationary phase and a moving phase. A suitable synthetic zeolite and suitable detector are used in chromatography.

When the accuracy of analysis is to be achieved at the level of 1 ppm (v/v) [vpm], the results obtained are always relative to the impurities of carrier gas and are not absolute values. Hence, the ultra-high purity carrier gas, that is, Grade 1 argon is to be purified further by a suitable rare gas purifier to achieve zero impurity carrier gas.

The purifier system consists of titanium granules at 700 °C for removal of nitrogen and oxygen, a copper oxide furnace for removal of hydrogen and carbon monoxide, and molecular sieve to remove carbon dioxide and moisture.

The construction of the gas chromatograph is the same as that of any gas chromatograph with a gas sampling valve and a loop of known volume. The column material is molecular sieve 5 A filled in stainless steel column of 4 m length and 4.6 mm internal diameter. The column is regenerated at 250 °C in a stream of argon for about 4 h.

The detector is the most important part of the whole assembly and is called argon discharge detector. Purified carrier argon gas, which passes through the detector chamber, is subjected to a strong electromagnetic field maintained between two electrodes by a high frequency generator. The resulting luminescence is modified subsequently by any other element passing through the chamber.

The high frequency generator is operated on a stabilized voltage. The luminous intensity of the gas discharge tube is measured by means of a photo resistive cell, which is one of the branches of the bridge whose unbalanced voltage is the output signal for recording or integrating.

Alternatively, these impurities can be measured in a gas chromatograph having flame ionization detector (FID) with methanizer. Column in GC in this case will be carbon molecular sieve ST 100/120 mesh, 2 meters, 1.16" OD. The oven temperature and detector temperature are to be kept at 90 °C and 200 °C respectively. Carrier gas is the same that is grade 1 argon as specified earlier. One typical calibration chromatogram and one typical sample chromatogram is attached in Fig. 3 and Fig. 4.

NOTE — Performance of methanizer shall be tested periodically using the calibration gas.

Sample Name: STD10PPM CO+CO2+CH4Each +Bal.N2

```
=====
Acq. Operator   : SYSTEM
Sample Operator : SYSTEM
Acq. Instrument : GC Methaniser
Location        : Vial 1
Inj Volume      : 1000 µl
Acq. Method     : C:\CHEM32\2\METHODS\7890-0355.M
Last changed    : 01/25/2019 9:21:28 AM by SYSTEM
Analysis Method : C:\CHEM32\2\METHODS\COOLING.M
Last changed    : 02/10/2019 1:59:06 PM by SYSTEM
=====
```

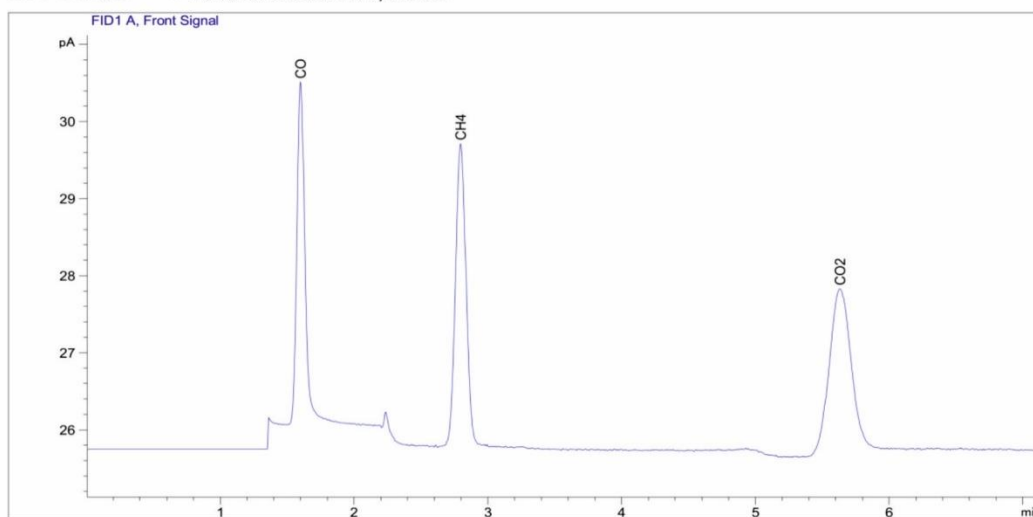


Figure 3 - Calibration Chromatogram

=====
Area Percent Report
=====

```
Sorted By      : Signal
Calib. Data Modified : Friday, January 25, 9:21:28 AM
Multiplier     : 1.0000
Dilution       : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A, Front Signal

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Area %	Name
1	1.600	BB	0.0610	17.29662	27.88937	CO
2	2.797	BB	0.0846	21.36391	34.44753	CH4
3	5.632	BB	0.1687	23.35816	37.66310	CO2

Totals : 62.01869

GC Methaniser 02/10/2019 1:59:06 PM SYSTEM

Calibration Chromatogram with details

FIG. 3 CALIBRATION CHROMATOGRAM

Sample Name: Oxygen

```

=====
Acq. Operator   : SYSTEM
Sample Operator : SYSTEM
Acq. Instrument : GC Methaniser
Location        : Vial 1
Inj Volume      : 1000 µl
Acq. Method     : C:\CHEM32\2\METHODS\7890-0355.M
Last changed    : 01/25/2019 9:21:28 AM by SYSTEM
Analysis Method : C:\CHEM32\2\METHODS\COOLING.M
Last changed    : 02/10/2019 1:59:06 PM by SYSTEM
=====

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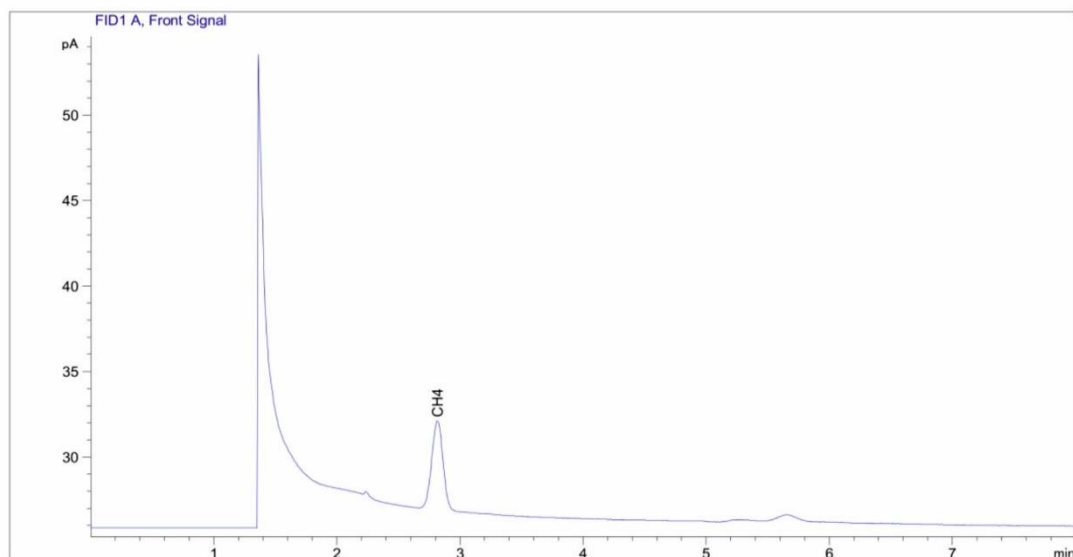


Figure 4 - Sample Chromatogram

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=====
Area Percent Report
=====

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Sorted By      : Signal
Calib. Data Modified : Friday, January 25, 9:21:28 AM
Multiplier     : 1.0000
Dilution       : 1.0000
Use Multiplier & Dilution Factor with ISTDs

```

Signal 1: FID1 A, Front Signal

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Area %	Name
1	1.364	BB	0.0683	148.85118	81.84722	?
2	1.598		0.0000	0.00000	0.00000	CO
3	2.817	BB	0.0992	33.01348	18.15278	CH4
4	5.611		0.0000	0.00000	0.00000	CO2

Totals : 181.86467

GC Methaniser 02/10/2019 2:31:08 PM SYSTEM

Sample Chromatogram with details

FIG. 4 SAMPLE CHROMATOGRAM

Gas chromatograph method for determination of carbon monoxide, carbon dioxide and hydrocarbon:

Detector = FID with methanizer

Column = Sh-carb (or equivalent) ST 100/120 mesh, 2 m, 1.16" OD.

Oven temp = 90 °C

Detector temp = 200 °C

Used standard (9 ppm CO, CH₄ and CO₂ each)

Ret. Time of peak -	peak area
CO = 1.60 min	17.29
CH ₄ = 2.79 min	21.36
CO ₂ = 5.63 min	23.35

Testing of oxygen results,

Ret. Time of peak -	peak area
CO = 1.59 min	Nil (no detection)
CH ₄ = 2.91 min	33.01
CO ₂ = 5.61 min	Nil (no detection)

As per calculation CH₄ present in oxygen = (10x33.013 / 21.363 x 91) ppm = 15.45 ppm.

Chromatograms attached both for calibration and sample run.

Report for a typical sample tested.

Typical calculation for the impurities — CO, CO₂, and hydrocarbon.

B-1.2 Procedure

Calibrate the instrument against calibration gas of known composition by measuring the peak heights or areas under various peaks of the chromatograph following the instructions of the manufacturer. Carry out the test according to the manufacturer's instructions and compute the concentration of the various impurities by comparing the peaks or the areas under peaks with that of the calibration gas.

B-2 INFRA-RED ANALYSER

Infra-red analysers are used for determining impurities of hetero atomic gases. The hetero atomic gases absorb energy at characteristic wavelengths when subjected to infra-red radiation. The procedure to be followed for determining the impurities shall depend on the type of apparatus used. The instrument manufacturer's instructions in this regard shall be followed.

B-3 CAVITY RING DOWN LASER ABSORPTION SPECTROSCOPIC METHOD

B-3.1 Principle

Cavity ring down laser absorption spectroscopy works on measurement of absolute optical extinction by samples capable of scattering and absorbing light. It uses a laser to quantify spectral features of gas phase molecules in an optical cavity.

A typical CRDS setup consists of a laser that is used to illuminate a high-finesse optical-cavity, which in its simplest form consists of two highly reflective mirrors. When the laser is in resonance with a cavity mode, intensity builds up in the cavity due to constructive interference. The laser is then turned off in order to allow the measurement of the exponentially decaying light intensity leaking from the cavity. During this decay, light is reflected back and forth thousands of times between the mirrors giving an effective path length for the extinction on the order of a few kilometers. Thus, simply it can be stated that, the gaseous samples absorb light of specific wavelength which in turn determines the mole fractions.

B-3.2 Calibration

Calibrations are to be carried out at defined frequency as per manufacturer's instruction. In some cases where there is demand of non-requirement of calibration, the function checking need to be done with standard reference gas. The standard gas used should have traceability and prepared according to IS/ISO 17034.

B-3.3 Procedure

Generally, an external pump is required which comes along with the instrument itself. Analytical equipment suppliers provide simple, ready to run portable units for this purpose. Cylinder of standard gas with appropriate regulator and fittings can be connected with the inlet port of the CRDS analyzer and do the calibration as per the operation manual of the instrument. This type of analyzer can be configured automatically to deliver data in the format suited for application. Digital (RS-232) or analogue data can be transmitted via ethernet as per user's instruction whereby the concentrations are recorded.

B-4 ELECTROCHEMICAL METHOD

When a gas containing carbon dioxide passes through a reactive liquid, the electrical conductivity of the liquid changes depending on the carbon dioxide content. The measurement of the change in electrical conductivity gives a direct measurement of the carbon dioxide content. The procedure to be followed shall depend upon the type of apparatus

used. The instrument manufacturer's instructions in this regard shall be followed.

B-5 TOTAL HYDROCARBON ANALYSER METHOD

B-5.1 Principle

The sample containing hydrocarbon impurities is burnt in a jet of hydrogen in the flame ionization detector. The organic component present in the sample gas acts as the source of ions. Concentration of ions is proportional to the concentration of organic components. Electrodes having considerable potential difference between them are used to measure the current produced due to ionization and the instrument is calibrated in the terms of concentration of hydrocarbons.

B-5.2 Procedure

Calibrate the instrument against calibration gas of known concentration of hydrocarbon following the instructions of the manufacturer. Then carry out the test according to the manufacturer's instructions.

B-6 SPECTRA ANALYSIS METHOD

B-6.1 Principle

The spectra analyser determines nitrogen in oxygen in the range of 0 ppm to 100 ppm (v/v). The analyser is based around a pyrex/quartz cell through which the test gas is passed. A high a.c. voltage is applied to this cell which causes ionization of the gas and consequent emission of light. A particular and proportionate fraction of this light results from the ionization of nitrogen which is present in the sample. The intensity of emission of light is proportional to the nitrogen concentration. The emitted light is passed through a chopper and narrow band interference filter. The transmitted light, which is proportional to the nitrogen present in the test gas, is detected by a photo multiplier tube and converted into electrical signal. The signal is pre amplified and measured. The analyser is to be calibrated by a standard gas.

B-6.2 Procedure

The procedure to be followed shall depend upon the type of apparatus used. The instrument manufacturer's instructions in this regard shall be followed.

B-7 ELECTROLYTIC HYGROMETER

The method is based on the absorption and electrolysis of the water vapour present in the sample gas. The electrolytic current gives a direct measurement of water vapour present in the gas flowing through the instrument at a steady rate. The exact procedure to be followed shall depend on the type of apparatus to be used. The instrument

manufacturer's instructions in this regard shall be followed.

B-8 FROST OR DEW POINT HYGROMETER

A metal surface on the hygrometer is cooled so that dew or frost is formed from the water vapour content of the gas at a particular pressure which may be observed optically in the apparatus. The temperature at which the dew or frost is formed is a measure of water vapour content of the gas. The exact procedure to be followed shall depend upon the type of apparatus to be used. The instrument manufacturer's instructions in this regard shall be followed.

B-9 CAPACITANCE HYGROMETER

The method is based on the change of capacitance of the sensor when a sample gas containing water vapour passes through it. The change in capacitance gives a direct measurement of water vapour present in the gas. The procedure to be followed shall depend upon the type of apparatus to be used. The instrument manufacturer's instructions in this regard shall be followed.

B-10 ABSORPTION METHOD

B-10.1 Apparatus

The apparatus consists of the following parts assembled as shown in Fig. 5.

B-10.1.1 Gas Meter — accurate to 1 percent

B-10.1.2 Absorption Train

Three U-tubes containing phosphorus pentoxide connected in series to the gas meter. The one near to the gas meter will serve as a guard to prevent moisture from backing into the first two tubes.

B-10.2 Procedure

Connect the 3 tubes in series to the inlet of the gas meter and connect the free end of U-tubes to the gas sample. Allow the gas to flow through the train for a while to saturate the water in the gas meter with the gas as well as replacing the air in the first two U-tubes. Stop the gas flow, close the stopcocks of the U-tubes and weigh the first two U-tubes. Connect again, record the meter reading. Pass the gas through the train at the rate of 10 litres per hour for 4 h to 5 h. Remove the first two U-tubes and weigh. Close the gas supply and record the meter reading.

B-10.3 Calculation

Convert the volume of gas taken for the test to normal temperature and pressure. From the increase in weight, calculate the volume of water vapour present on the basis that 1 g of water is equivalent to 1.244 litre of water vapour at normal temperature and pressure and express the result as parts per million volume by volume.

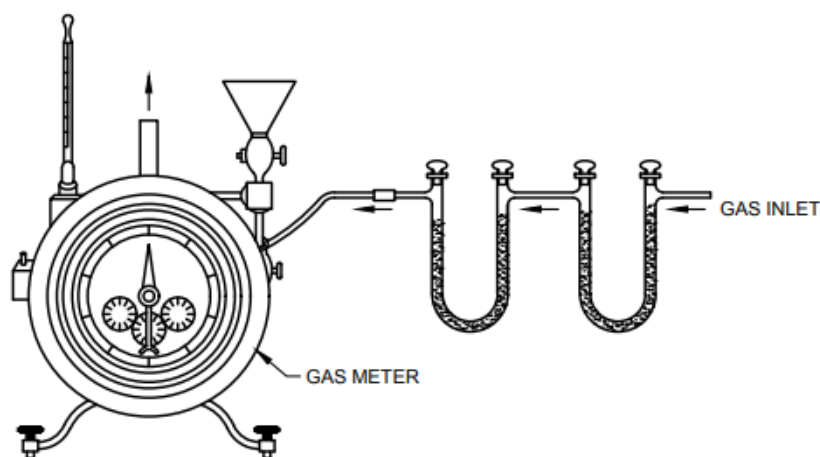


FIG. 5 ASSEMBLY OF APPARATUS FOR THE DETERMINATION OF MOISTURE

ANNEX C

(Clause 7)

SAMPLING OF OXYGEN

C-1 SAMPLING OF COMPRESSED OXYGEN

C-1.1 Lot

C-1.1.1 In any consignment, all cylinders charged at a time from one charging manifold shall constitute a lot. The number of cylinders (n) to be selected from a lot shall depend on the size of the lot (N) and shall be in accordance with col (1) and col (2) of Table 2.

C-1.1.2 The cylinders shall be selected at random and in order to ensure the randomness of selection, either the procedures given in IS 4905 or the following procedure shall be followed.

Starting from any cylinder in the lot, count them in one order as 1,2,3 up to r and so on, where r is an integral part of N/n . Every r^{th} cylinder thus counted shall be withdrawn to give the sample for test.

C-1.2 Test Samples

A sample of gas shall be drawn from each cylinder selected as in **C-1.1.2** and it shall be the individual test sample from each cylinder.

C-1.3 Number of Tests

All the individual test samples in **C-1.2** shall be

tested separately for the requirements given in Table 1.

Table 2 Number of Cylinders to be Selected (Clause C-1.1.1)

Sl No.	Lot size	Number of Cylinders to be Selected
		(n)
(1)	(2)	(3)
i)	Up to 50	5
ii)	51 to 100	8
iii)	101 to 150	15
iv)	151 to 300	20
v)	301 and above	25

C-1.4 Criteria for Conformity

A lot shall be declared as conforming to the requirements of this specification if all individual samples tested, pass the requirements prescribed in Table 1.

C-2 SAMPLING OF LIQUID OXYGEN

C-2.1 Generally, the production of liquid oxygen is a continuous process, and the plant runs without stoppage. A sample taken at random from any specific production day in a week may be considered as a representative test sample for that week. One such sample in the liquid form shall be collected in a specially designed cryogenic container from which the sample in gas phase can be taken for all the tests mentioned in Table 1. However, in case of start-up of an oxygen plant, that is, at the very beginning and /or after stoppage due to any issues, one sample in the liquid form shall be collected in a specially designed cryogenic container and the tests mentioned in Table 1 shall be carried out. The

frequency of testing for the liquid samples may be increased only on agreement between the buyer and the seller.

NOTE — Specially designed cryogenic container may be vacuum insulated storage tanker/vacuum insulated transport tanker/cryogenic can with an arrangement by which gaseous sample can be fed into the apparatus/instrument(s), as applicable.

C-2.2 CRITERIA FOR CONFORMITY

A Test sample shall be declared as conforming to the requirements of this specification if all individual samples tested, pass the requirements prescribed in Table 1.

ANNEX D*(Foreword)***COMMITTEE COMPOSITION**

Industrial Gases Sectional Committee, CHD 06

<i>Organization</i>	<i>Representative(s)</i>
CSIR - National Physical Laboratory, New Delhi	DR CHHEMENDRA SHARMA (<i>Chairperson</i>)
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